US009459141B2

(12) **United States Patent**
Lin

(10) **Patent No.: US 9,459,141 B2**
(45) **Date of Patent: Oct. 4, 2016**

(54) **BRIGHTNESS CONTROL APPARATUS AND BRIGHTNESS CONTROL METHOD**

(71) Applicant: **GETAC TECHNOLOGY CORPORATION**, Hsinchu County (TW)
(72) Inventor: **Chia-Huang Lin**, New Taipei (TW)
(73) Assignee: **Getac Technology Corporation**, Hsinchu County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 144 days.
(21) Appl. No.: **14/205,280**
(22) Filed: **Mar. 11, 2014**
(65) **Prior Publication Data**

US 2015/0262548 A1 Sep. 17, 2015

(51) **Int. Cl.**

G09G 5/02	(2006.01)
G01J 1/42	(2006.01)
G01K 13/00	(2006.01)
G09G 5/10	(2006.01)
G06F 3/14	(2006.01)

(52) **U.S. Cl.**
CPC ***G01J 1/42*** (2013.01); ***G01K 13/00*** (2013.01); ***G09G 5/10*** (2013.01); *G06F 3/14* (2013.01); *G09G 2320/041* (2013.01); *G09G 2320/0626* (2013.01); *G09G 2330/02* (2013.01); *G09G 2330/045* (2013.01); *G09G 2360/144* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,172,611	B1 *	1/2001	Hussain	G06F 1/206 340/584
7,183,727	B2 *	2/2007	Ferguson	H05B 41/3922 315/149
8,176,308	B2 *	5/2012	Chiu	G06F 1/26 713/2
2003/0169226	A1 *	9/2003	Yamada	H05B 33/0818 345/102
2004/0061708	A1 *	4/2004	Oh	G09G 3/3611 345/690
2004/0178974	A1	9/2004	Miller et al.	
2004/0233125	A1 *	11/2004	Tanghe	G06F 3/1446 345/1.3
2005/0041008	A1 *	2/2005	Lee	G09G 3/3406 345/102
2006/0017404	A1 *	1/2006	Jang	G09G 3/3406 315/291
2006/0155517	A1 *	7/2006	Dobbs	G06F 11/3058 702/188
2006/0256067	A1 *	11/2006	Montero	G09G 3/3406 345/102
2006/0274023	A1 *	12/2006	Sultenfuss	G09G 3/3406 345/102
2007/0085785	A1 *	4/2007	Ozaki	G09G 3/2025 345/77
2007/0090962	A1 *	4/2007	Price	G08B 5/36 340/691.1
2007/0091057	A1 *	4/2007	Lee	G09G 3/3413 345/102
2007/0182378	A1 *	8/2007	Tsuji	G01R 31/3606 320/132
2008/0192140	A1 *	8/2008	Lee	G06F 3/14 348/362
2009/0058887	A1 *	3/2009	Lin	G06F 3/14 345/690
2009/0289965	A1	11/2009	Kurokawa et al.	
2011/0234651	A1 *	9/2011	Chen	G09G 5/10 345/690
2012/0297224	A1 *	11/2012	Chen	G06F 1/3265 713/322
2013/0061081	A1 *	3/2013	Lee	G06F 1/206 713/324
2013/0120480	A1	5/2013	Takada et al.	
2013/0215093	A1	8/2013	Bergquist et al.	
2014/0240377	A1 *	8/2014	Matsui	G09G 3/3406 345/690

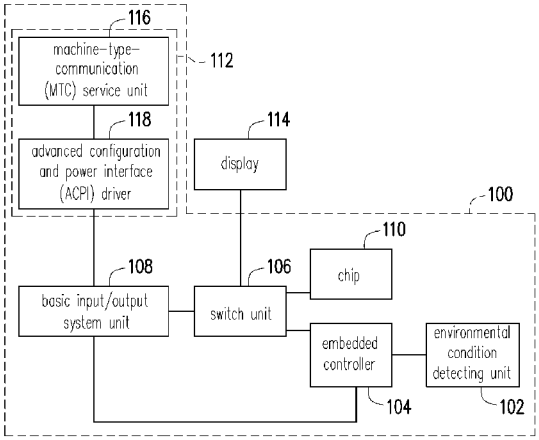
* cited by examiner

Primary Examiner — Barry Drennan
Assistant Examiner — Jason Pringle-Parker

(57) **ABSTRACT**

A brightness control apparatus and a brightness control method are provided. A basic input/output system unit determines to let a chip or an embedded controller to control the brightness of a display according to an environmental condition or an adjustment operation of a user.

18 Claims, 3 Drawing Sheets



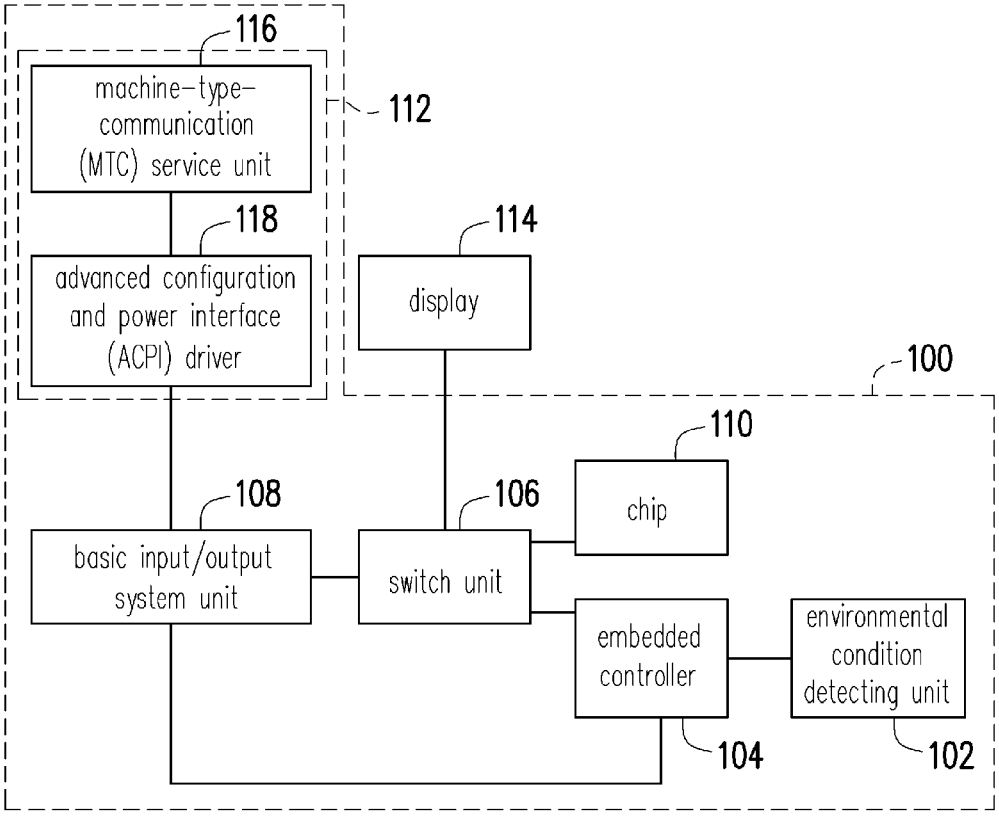

116
machine-type-communication (MTC) service unit
112
118
advanced configuration and power interface (ACPI) driver
114
display
100
110
chip
108
basic input/output system unit
106
switch unit
embedded controller
environmental condition detecting unit
104
102

FIG. 1

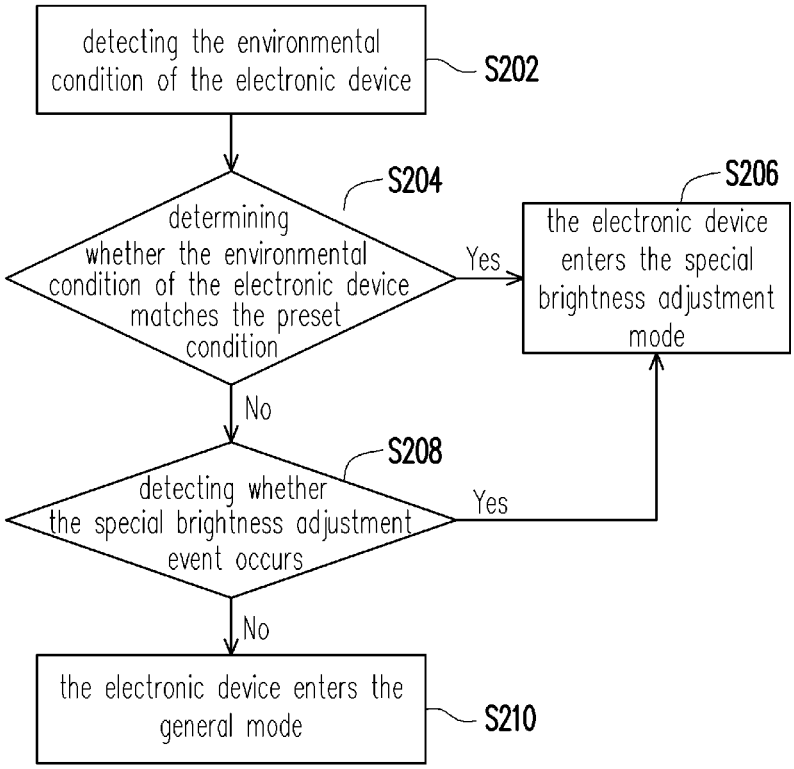

detecting the environmental condition of the electronic device
S202
S204
determining whether the environmental condition of the electronic device matches the preset condition
Yes
S206
the electronic device enters the special brightness adjustment mode
No
S208
detecting whether the special brightness adjustment event occurs
Yes
No
the electronic device enters the general mode
S210

FIG. 2

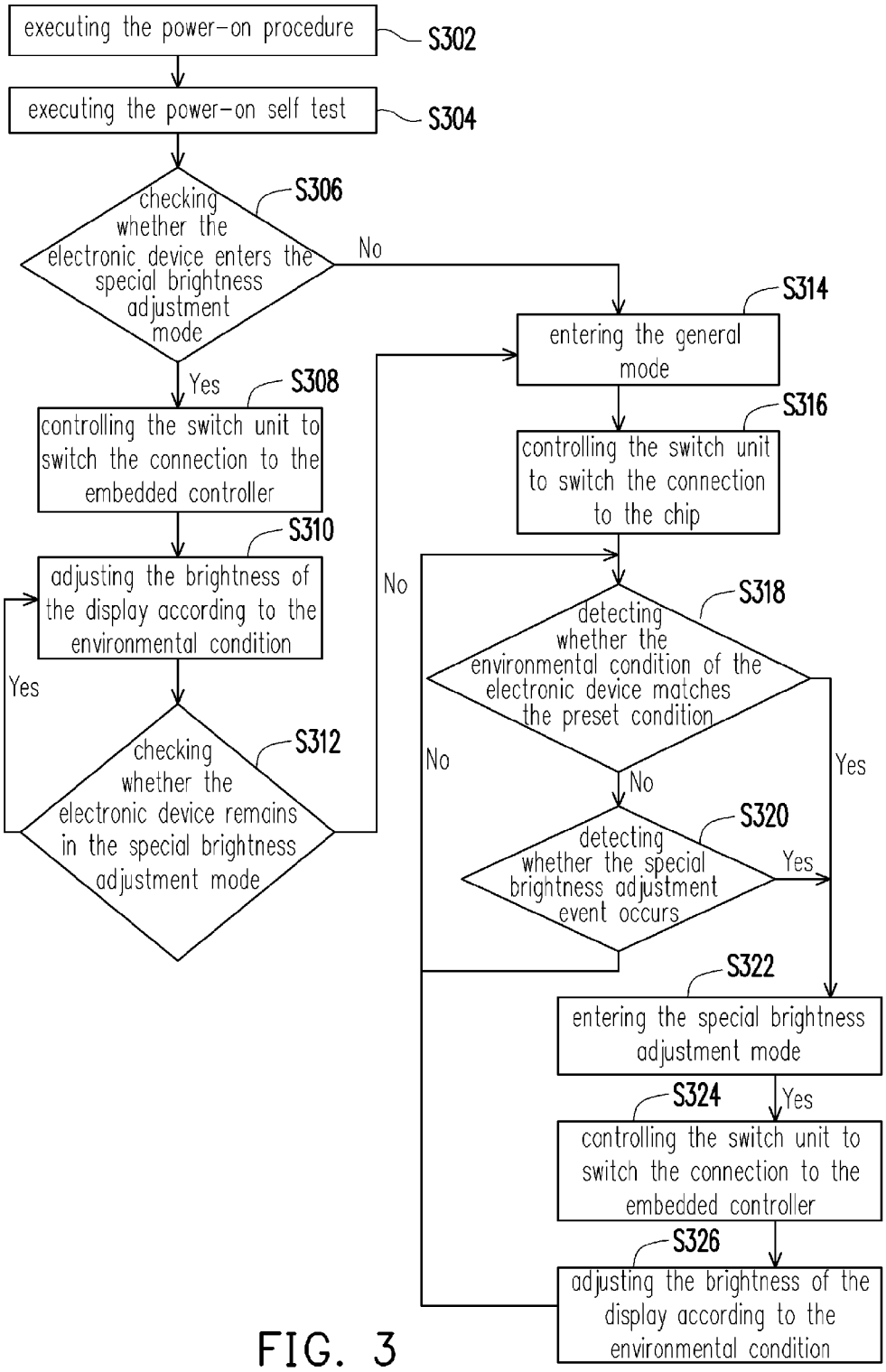

executing the power-on procedure
S302
executing the power-on self test
S304
checking whether the electronic device enters the special brightness adjustment mode
S306
No
Yes
S308
controlling the switch unit to switch the connection to the embedded controller
S310
adjusting the brightness of the display according to the environmental condition
Yes
checking whether the electronic device remains in the special brightness adjustment mode
S312
No
entering the general mode
S314
controlling the switch unit to switch the connection to the chip
S316
detecting whether the environmental condition of the electronic device matches the preset condition
S318
No
Yes
No
detecting whether the special brightness adjustment event occurs
S320
Yes
entering the special brightness adjustment mode
S322
Yes
controlling the switch unit to switch the connection to the embedded controller
S324
adjusting the brightness of the display according to the environmental condition
S326

FIG. 3

BRIGHTNESS CONTROL APPARATUS AND BRIGHTNESS CONTROL METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a control apparatus and particularly relates to a brightness control apparatus and a brightness control method.

2. Description of Related Art

Computers may be categorized into rugged computers and general computers, and the difference is that rugged computers are often used in harsh environments, such as high-temperature or low-temperature environments. Therefore, rugged computers are required to have much higher adaptability to the environmental temperature than the general computers. Factors, such as compactness and light weight, which may be important to general computers, are not the main concerns for rugged computers.

When a rugged computer is operated in a harsh environment, such as at high temperature or low temperature, the brightness of the display may need to be controlled from time to time in order to maintain normal operations of the rugged computer. For example, the brightness of the display needs to be reduced at a high temperature so as to prevent the problem of black screen. For powering on at a low temperature, the brightness of the display needs to be reduced to prevent excessive power consumption (because low-temperature power-on procedure takes more time and the power of other elements needs to be adjusted for heating). In a situation of heavy load, the brightness of the display also needs to be reduced to lower power consumption.

Before the window operating system Windows 8 appears, the brightness of the display is controlled by a pulse width modulation signal outputted by an embedded controller, so as to achieve the aforementioned function of brightness adjustment. However, under the configuration of Windows 8, the brightness of the display is controlled by the Windows Display Driver Model (WDDM). In other words, the brightness of the display is controlled by the pulse width modulation signal outputted by the Platform Controller Hub (PCH) under control of a driver of the Windows Display Driver Model (WDDM). For this reason, the brightness of the display cannot be adjusted by the traditional way in conditions of high temperature, low temperature, or heavy load to maintain normal operation of the computer.

SUMMARY OF THE INVENTION

The invention provides a brightness control apparatus and a brightness control method for adjusting a display to a special brightness, so as to meet an adjustment demand of the user or ensure a normal operation of an electronic device.

A brightness control method of the invention is adapted for a display of an electronic device and includes the following steps. An environmental condition of the electronic device is detected. Whether the environmental condition of the electronic device matches a preset condition is determined. The electronic device enters a special brightness adjustment mode if the environmental condition matches the preset condition. The brightness of the display is controlled by an embedded controller in the special brightness adjustment mode.

In an embodiment of the invention, the preset condition includes that an environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature. The determining step further includes: determining whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental condition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature. The step of entering the special brightness adjustment mode further includes that: the embedded controller adjusts the brightness of the display to be lower than a preset low brightness.

In an embodiment of the invention, the preset condition includes that an environmental light intensity is higher than a preset light intensity. The determining step further includes: determining whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity. The step of entering the special brightness adjustment mode further includes that: the embedded controller adjusts the brightness of the display to be higher than a preset high brightness.

In an embodiment of the invention, the following steps are executed if the environmental condition does not match the preset condition. Whether a special brightness adjustment event occurs is detected. The electronic device enters the special brightness adjustment mode if the special brightness adjustment event occurs. The electronic device enters a general mode if the special brightness adjustment event does not occur, wherein the brightness of the display is controlled by a chip in the general mode.

In an embodiment of the invention, the step of detecting whether the special brightness adjustment event occurs includes: detecting whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, wherein the first threshold brightness is greater than the second threshold brightness.

In an embodiment of the invention, the step of detecting the environmental condition of the electronic device is to detect the environmental condition of the electronic device in a period of a power-on self test.

A brightness control method of the invention is adapted for a display of an electronic device and includes: detecting an environmental condition of the electronic device. Whether the environmental condition of the electronic device matches a preset condition is determined. If the environmental condition does not match the preset condition, the following steps are executed: detecting whether a special brightness adjustment event occurs. The electronic device enters a special brightness adjustment mode if the special brightness adjustment event occurs, wherein the brightness of the display is controlled by an embedded controller in the special brightness adjustment mode.

In an embodiment of the invention, the brightness control method further includes: causing the electronic device to enter a general mode if the special brightness adjustment event does not occur, wherein the brightness of the display is controlled by a chip in the general mode.

In an embodiment of the invention, the preset condition includes that an environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature. The determining step further includes: determining whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental con-

dition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature.

In an embodiment of the invention, the preset condition includes that an environmental light intensity is higher than a preset light intensity. The determining step further includes: determining whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity.

In an embodiment of the invention, the step of detecting whether the special brightness adjustment event occurs includes: detecting whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, wherein the first threshold brightness is greater than the second threshold brightness.

In an embodiment of the invention, the step of detecting the environmental condition of the electronic device is to detect the environmental condition of the electronic device in a period of a power-on self test.

A brightness control apparatus of the invention is adapted for controlling a brightness of a display of an electronic device, and the brightness control apparatus includes an environmental condition detecting unit, an embedded controller, a switch unit, and a basic input/output system unit. The environmental condition detecting unit is configured to detect an environmental condition of the electronic device. The embedded controller is coupled to the environmental condition detecting unit and configured to determine whether the environmental condition of the electronic device matches a preset condition. The switch unit is coupled to the embedded controller and the display. The basic input/output system unit is coupled to the embedded controller and the switch unit and configured to control the switch unit to electrically connect the display to the embedded controller to cause the electronic device to enter a special brightness adjustment mode if the environmental condition matches the preset condition, wherein the brightness of the display is controlled by the embedded controller in the special brightness adjustment mode.

In an embodiment of the invention, the environmental condition includes at least one of an environmental temperature and an environmental light intensity.

In an embodiment of the invention, the preset condition includes that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature; wherein the embedded controller further determines whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental condition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature; and wherein the embedded controller further notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode when the environmental condition matches the preset condition, and the embedded controller adjusts the brightness of the display to be lower than a preset low brightness after the electronic device enters the special brightness adjustment mode.

In an embodiment of the invention, the preset condition includes that the environmental light intensity is higher than a preset light intensity. The embedded controller further determines whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity. The embedded controller further notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode when the environmental condition matches the preset condition, and the embedded controller adjusts the brightness of the display to be higher than a preset high brightness after the electronic device enters the special brightness adjustment mode.

In an embodiment of the invention, the brightness control apparatus further includes a chip and an adjustment detecting unit. The chip is coupled to the switch unit. The adjustment detecting unit is coupled to the basic input/output system unit and configured to detect whether a special brightness adjustment event occurs, wherein in a situation that the environmental condition does not match the preset condition, if the special brightness adjustment event occurs, the basic input/output system unit controls the switch unit to electrically connect the display to the embedded controller to cause the electronic device to enter the special brightness adjustment mode. If the special brightness adjustment event does not occur, the basic input/output system unit controls the switch unit to electrically connect the display to the chip to cause the electronic device to enter a general mode, wherein the brightness of the display is controlled by the chip in the general mode.

In an embodiment of the invention, the adjustment detecting unit further detects whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, so as to determine whether the special brightness adjustment event occurs, wherein the first threshold brightness is greater than the second threshold brightness.

In an embodiment of the invention, the environmental condition detecting unit further detects the environmental condition in a period of a power-on self test, and the embedded controller further determines whether the environmental condition matches the preset condition in the period of the power-on self text, wherein the embedded controller notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode if the environmental condition matches the preset condition.

Based on the above, the invention determines whether to use the chip or the embedded controller to control the brightness of the display through the basic input/output system unit according to the environmental condition or the adjustment made by the user, so as to meet the demand of the user or ensure normal operation of the electronic device.

To make the above features and advantages of the invention more comprehensible, several embodiments accompanied with drawings are described in detail as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a schematic diagram of a brightness control apparatus according to an embodiment of the invention.

FIG. **2** is a schematic diagram showing a brightness control method according to an embodiment of the invention.

FIG. **3** is a schematic diagram showing a brightness control method according to another embodiment of the invention.

DESCRIPTION OF THE EMBODIMENTS

FIG. **1** is a schematic diagram of a brightness control apparatus according to an embodiment of the invention. With reference to FIG. **1**, a brightness control apparatus **100** includes an environmental condition detecting unit **102**, an embedded controller **104**, a switch unit **106**, a basic input/output system unit **108**, a chip **110**, and an adjustment detecting unit **112**. The brightness control apparatus **100** is configured to control a brightness of a display **114** of an electronic device. The electronic device may be a notebook computer, a desktop computer, or the like, for example. The chip **110** may be a south bridge chip, for example. The adjustment detecting unit **112** is coupled to the basic input/output system unit **108**. The basic input/output system unit **108** is coupled to the switch unit **106** and the embedded controller **104**. The switch unit **106** is coupled to the embedded controller **104**, the chip **110**, and the display **114**. The embedded controller **104** is coupled to the environmental condition detecting unit **102**.

The environmental condition detecting unit **102** is configured for detecting an environmental condition of the electronic device. The embedded controller **104** is capable of determining whether the environmental condition of the electronic device matches a preset condition, wherein the environmental condition may include at least one of an environmental temperature and an environmental light intensity. The basic input/output system unit **108** controls the switch unit **106** to electrically connect the display **114** to the embedded controller **104** or the chip **110** according to a determination result of the embedded controller **104**, wherein, when the display **114** is electrically connected to the chip **110** through the switch unit **106**, the electronic device is in a general mode, and the brightness of the display **114** is controlled by the chip **110**. When the display **114** is electrically connected to the embedded controller **104** through the switch unit **106** (that is, the brightness of the display **114** is controlled by the embedded controller **104**), the electronic device is in a special brightness adjustment mode. Unlike the chip **110**, the embedded controller **104** is not restricted by Windows 8 operating system. Therefore, the adjustment range of the brightness of the display **114** in the special brightness adjustment mode is larger than an adjustment range in the general mode.

To be more specific, the aforementioned preset condition may include that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature. The embedded controller **104** determines whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature based on the environmental condition outputted by the environmental condition detecting unit **102**. If the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, namely, the environmental temperature is too high or too low and exceeds a normal temperature range, the embedded controller **104** determines that the environmental condition matches the preset condition. Meanwhile, the embedded controller **104** notifies the basic input/output system unit **108** to cause the electronic device to enter the special brightness adjustment mode, such that the brightness of the display **114** is under control of the embedded controller **104**, and then the embedded controller **104** adjusts the brightness of the display **114** to be lower than a preset low brightness, so as to achieve the purpose of over-temperature protection or low-temperature use.

It should be noted that, in order to ensure that the electronic device operates properly in an extreme environmental temperature condition, the environmental condition detecting unit **102** may detect the environmental condition during a period of power-on self test. If the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, the embedded controller **104** determines that the environmental condition matches the preset condition and notifies the basic input/output system unit **108** to cause the electronic device to enter the special brightness adjustment mode directly. Consequently, the electronic device enters the special brightness adjustment mode without going through the aforementioned over-temperature protection mechanism after the power-on is finished.

In addition, the embedded controller **104** also determines whether the environmental light intensity is higher than a preset light intensity. If the environmental light intensity is higher than the preset light intensity and causes that the user is not able to see the content shown by the display clearly, the embedded controller **104** determines that the environmental condition matches the preset condition. Meanwhile, the embedded controller **104** also notifies the basic input/output system unit **108** to cause the electronic device to enter the special brightness adjustment mode. When the electronic device enters the special brightness adjustment mode, the embedded controller **104** adjusts the brightness of the display **114** to be higher than a preset high brightness, so as to overcome the problem that the environmental light intensity affects the user's viewing of the content shown by the display.

In addition to automatically adjusting the electronic device to the special brightness adjustment mode according to the environmental condition, the brightness control apparatus **100** may also cause the electronic device to enter the special brightness adjustment mode according to an operation of the user. As shown in FIG. **1**, the adjustment detecting unit **112** in the brightness control apparatus **100** may include a machine-type-communication (MTC) service unit **116** and an advanced configuration and power interface (ACPI) driver **118**, wherein the machine-type-communication service unit **116** is configured to determine whether a brightness adjustment command is received. If the brightness adjustment command is received, the advanced configuration and power interface driver **118** is controlled to drive the basic input/output system unit **108**. In a situation that the environmental condition does not match the preset condition, the adjustment detecting unit **112** may detect whether a special brightness adjustment event occurs. If the special brightness adjustment event occurs, the basic input/output system unit **108** may also control the switch unit **106** to electrically connect the display **114** to the embedded controller **104**, so as to cause the electronic device to enter the special brightness adjustment mode. The special brightness adjustment event may be triggered, for example, when the user adjusts the brightness of the display **114** to be higher than a first threshold brightness or lower than a second threshold brightness, wherein the first threshold brightness is greater than the second threshold brightness. The first threshold brightness and the second threshold brightness may respectively rep-

resent a maximum brightness and a minimum brightness that the chip **110** may control the display **114** to display, and they are brightness limits of the display **114** under the configuration of Windows 8 operating system. When the user adjusts the brightness of the display **114** to be lower than the first threshold brightness or higher than the second threshold brightness (namely, adjusts the brightness of the display **114** back to a brightness range under control of the chip **110**), the basic input/output system unit **108** again controls the switch unit **106** to electrically connect the display **114** to the chip **110**, so as to turn the electronic device back to the general mode.

Here, in this embodiment, the brightness of the display **114** is adjusted to be higher than the first threshold brightness or lower than the second threshold brightness in a progressive manner. The user may use a physical or virtual brightness adjustment button of the electronic device to progressively adjust the brightness of the display **114** from the brightness range controllable by the chip **110** to outside the brightness range controllable by the chip **110**, so as to cause the electronic device to enter the special brightness adjustment mode. That is, the adjustment detecting unit **112** is capable of detecting whether a special brightness adjustment command is received, wherein the special brightness adjustment command instructs to directly adjust the brightness of the display **114** to be higher than the first threshold brightness or lower than the second threshold brightness. If the adjustment detecting unit **112** receives the special brightness adjustment command, it determines that the special brightness adjustment event occurs and notifies the basic input/output system unit **108** to control the switch unit **106** to electrically connect the display **114** to the embedded controller **104**, so as to cause the electronic device to enter the special brightness adjustment mode directly and adjust the brightness of the display **114** to be higher than the first threshold brightness or lower than the second threshold brightness.

It should be noted that the preset high brightness and the preset low brightness may be brightness limits that the display **114** presents under restriction of the configuration of Windows 8 operating system, which are the first threshold brightness and the second threshold brightness. However, the invention is not limited thereto. The preset high brightness and the preset low brightness may respectively be a brightness value higher than the first threshold brightness and a brightness value lower than the second threshold brightness.

In some embodiments, a physical or virtual hotkey of the electronic device may be used to cause the electronic device to enter the special brightness adjustment mode directly. When the user touches the physical or virtual hotkey, the embedded controller **104** controls the switch unit **106** through the basic input/output system unit **108** to electrically connect the display **114** to the embedded controller **104**, so as to enter the special brightness adjustment mode, thereby enabling the embedded controller **104** to directly control the brightness of the display **114**.

The brightness control mechanism of the invention may simultaneously support display architectures of different operating systems. In some embodiments, if the electronic device uses Windows 8 as the operating system, control of the brightness of the display **114** is switched to the chip **110** or the embedded controller **104** through the switch unit **106**; however, if the electronic device uses Windows 7 as the operating system, the brightness of the display **114** is controlled by the embedded controller **104**.

FIG. **2** is a schematic diagram showing a brightness control method according to an embodiment of the invention. In view of the above, referring to FIG. **2**, a brightness control method of the aforementioned brightness control apparatus includes the following steps. First, an environmental condition of the electronic device is detected (Step S**202**), wherein the environmental condition may include at least one of an environmental temperature and an environmental light intensity. Next, whether the environmental condition of the electronic device matches a preset condition is determined (Step S**204**), wherein the preset condition may be that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, for example. When the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, it is determined that the environmental condition matches the preset condition. Or, the preset condition may be that the environmental light intensity is higher than a preset light intensity, for example. If the environmental light intensity is higher than the preset light intensity, it is determined that the environmental condition matches the preset condition.

If the environmental condition of the electronic device matches the preset condition, the electronic device enters a special brightness adjustment mode (Step S**206**), wherein in the special brightness adjustment mode, the brightness of the display of the electronic device is controlled by an embedded controller. Thus, the brightness presented by the display **114** is not restricted by the configuration of Windows 8 operating system. Furthermore, in the special brightness adjustment mode, in a situation that the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, the embedded controller adjusts the brightness of the display to be lower than a preset low brightness so as to achieve over-temperature protection. On the other hand, in a situation that the environmental light intensity is higher than the preset light intensity, the embedded controller adjusts the brightness of the display to be higher than a preset high brightness, so as to overcome the problem that the environmental light intensity affects the user's viewing of the content shown by the display.

It should be noted that the step of detecting the environmental condition of the electronic device (Step S**202**) may also be executed in a period of a power-on self test for the electronic device to enter the special brightness adjustment mode directly. Consequently, the electronic device enters the special brightness adjustment mode without going through the aforementioned over-temperature protection mechanism after the power-on is finished, thereby ensuring that the electronic device operates properly at an extreme temperature.

In contrast, if the environmental condition of the electronic device does not match the preset condition, whether a special brightness adjustment event occurs is detected (Step S**208**). For example, whether a special brightness adjustment command is received is detected, wherein the special brightness adjustment command instructs to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness. If the special brightness adjustment event occurs, Step S**206** is performed to cause the electronic device to enter the special brightness adjustment mode. If the special brightness adjustment event does not occur, the electronic device enters a general mode (Step S**210**), wherein in the general mode, the brightness of the display is controlled by a chip. That is,

the brightness of the display is restricted by the configuration of Windows 8 operating system.

FIG. **3** is a schematic diagram showing a brightness control method according to another embodiment of the invention. With reference to FIG. **3**, the brightness control method of this embodiment includes the following steps. First, a power-on procedure is executed (Step S**302**). Next, a power-on self test (POST) is executed (Step S**304**). Then, whether the electronic device enters a special brightness adjustment mode is checked (Step S**306**), which is for example to check whether an environmental condition of the electronic device matches a preset condition. If the electronic device is to enter the special brightness adjustment mode (e.g. the electronic device enters the special brightness adjustment mode when the environmental condition of the electronic device matches the preset condition), the switch unit is controlled to switch the connection to the embedded controller (Step S**308**). In contrast, if the electronic device does not enter the special brightness adjustment mode and enters the general mode (Step S**314**), the switch unit is controlled to switch the connection to the chip (Step S**316**) for the display to display a preset brightness. In the general mode, the brightness of the display is restricted by the configuration of Windows 8 operating system.

In the situation that the switch unit switches the connection to the embedded controller, the embedded controller then adjusts the brightness of the display according to the environmental condition (Step S**310**). Thereafter, whether the electronic device remains in the special brightness adjustment mode is checked (Step S**312**). If the electronic device remains in the special brightness adjustment mode (e.g. the electronic device remains in the special brightness adjustment mode when the environmental condition of the electronic device matches the preset condition), the method returns to Step S**310** to continue adjusting the brightness of the display according to the environmental condition. If the electronic device is not in the special brightness adjustment mode (e.g. the environmental condition of the electronic device does not match the preset condition), Step S**314** is performed to cause the electronic device to enter the general mode, and then Step S**316** is performed to control the switch unit to switch the connection to the chip, such that the brightness of the display is restricted by the configuration of Windows 8 operating system. After entering the general mode, the embedded controller may continue detecting whether the environmental condition of the electronic device matches the preset condition (Step S**318**). If the environmental condition of the electronic device does not match the preset condition, whether a special brightness adjustment event occurs is detected (Step S**320**). If no special brightness adjustment event occurs, the method goes back to Step S**318** to continue detecting whether the environmental condition of the electronic device matches the preset condition. If the special brightness adjustment event occurs or if the environmental condition of the electronic device is determined as matching the preset condition in Step S**318**, the electronic device enters the special brightness adjustment mode (Step S**322**) and then the switch unit is controlled to switch the connection to the embedded controller (Step S**324**) for the embedded controller to adjust the brightness of the display according to the environmental condition (Step S**326**). In addition, after the embedded controller adjusts the brightness of the display according to the environmental condition, the method may go back to Step S**318** to continue detecting whether the environmental condition of the electronic device matches the preset condition.

To sum up, the invention determines whether to use the chip or the embedded controller to control the brightness of the display through the basic input/output system unit according to the environmental condition or the adjustment made by the user, so as to meet the demand of the user or ensure normal operation of the electronic device. Moreover, because the brightness of the display can be controlled by the chip, the brightness of the display conforms to the test of Windows Hardware Certification Kit (WHCK). According to the invention, control of the electronic device over the brightness of the display is more flexible, and one brightness control apparatus can simultaneously support multiple operating systems.

Although the invention has been disclosed by the above embodiments, they are not intended to limit the invention. It will be apparent to those of ordinary skill in the art that modifications and variations to the invention may be made without departing from the spirit and the scope of the invention. Accordingly, the protection scope of the invention falls in the appended claims.

What is claimed is:

1. A brightness control method, adapted for a display of an electronic device, the electronic device comprising a chip and an embedded controller, the brightness control method comprising:

detecting an environmental condition of the electronic device;

determining whether the environmental condition of the electronic device matches a preset condition;

causing the electronic device to enter a special brightness adjustment mode when the environmental condition matches the preset condition, and causing the electronic device to enter a general mode when the environmental condition does not match the preset condition; and

executing the following steps when the environmental condition does not match the preset condition:

detecting whether a special brightness adjustment event occurs;

causing the electronic device to enter the special brightness adjustment mode if the special brightness adjustment event occurs; and

causing the electronic device to enter the general mode if the special brightness adjustment event does not occur, wherein the step of detecting whether the special brightness adjustment event occurs comprises detecting whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, wherein the first threshold brightness is greater than the second threshold brightness;

wherein a brightness of the display is controlled by the embedded controller independently of the chip in the special brightness adjustment mode, and the brightness of the display is controlled by the chip independently of the embedded controller in the general mode.

2. The brightness control method according to claim **1**, wherein the environmental condition comprises at least one of an environmental temperature and an environmental light intensity.

3. The brightness control method according to claim **2**, wherein the preset condition comprises that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature;

wherein the determining step further comprises: determining whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental condition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature; and

wherein the step of entering the special brightness adjustment mode further comprises that: the embedded controller adjusts the brightness of the display to be lower than a preset low brightness.

4. The brightness control method according to claim **2**, wherein the preset condition comprises that the environmental light intensity is higher than a preset light intensity;

wherein the determining step further comprises: determining whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity; and

wherein the step of entering the special brightness adjustment mode further comprises that: the embedded controller adjusts the brightness of the display to be higher than a preset high brightness.

5. The brightness control method according to claim **1**, wherein the step of detecting the environmental condition of the electronic device comprises detecting the environmental condition of the electronic device in a period of a power-on self test.

6. The brightness control method according to claim **1**, wherein the chip controls the brightness according an operating system of the device, and the embedded controller controls the brightness independently of the operating system.

7. A brightness control method, adapted for a display of an electronic device, the electronic device comprising a chip and an embedded controller, the brightness control method comprising:

detecting an environmental condition of the electronic device;

determining whether the environmental condition of the electronic device matches a preset condition; and

executing the following steps if the environmental condition does not match the preset condition:

detecting whether a special brightness adjustment event occurs, wherein the step of detecting whether the special brightness adjustment event occurs comprises detecting whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, wherein the first threshold brightness is greater than the second threshold brightness; and

causing the electronic device to enter a special brightness adjustment mode when the special brightness adjustment event occurs, and causing the electronic device to enter a general mode when the special brightness adjustment event does not occur;

wherein the brightness of the display is controlled by the embedded controller independently of the chip in the special brightness adjustment mode, and the brightness of the display is controlled by the chip independently of the embedded controller in the general mode.

8. The brightness control method according to claim **7**, wherein the environmental condition comprises at least one of an environmental temperature and an environmental light intensity.

9. The brightness control method according to claim **7**, wherein the preset condition comprises that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature; and

wherein the determining step further comprises: determining whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental condition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature.

10. The brightness control method according to claim **7**, wherein the preset condition comprises that the environmental light intensity is higher than a preset light intensity;

wherein the determining step further comprises: determining whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity.

11. The brightness control method according to claim **7**, wherein the step of detecting the environmental condition of the electronic device comprises detecting the environmental condition of the electronic device in a period of a power-on self test.

12. The brightness control method according to claim **7**, wherein the chip controls the brightness according an operating system of the device, and the embedded controller controls the brightness independently of the operating system.

13. A brightness control apparatus, adapted for controlling a brightness of a display of an electronic device, the brightness control apparatus comprising:

an environmental condition detecting unit detecting an environmental condition of the electronic device;

an embedded controller coupled to the environmental condition detecting unit and determining whether the environmental condition of the electronic device matches a preset condition;

a chip;

a switch unit coupled to the embedded controller, the chip and the display; and

a basic input/output system unit coupled to the embedded controller and the switch unit and controlling the switch unit to electrically connect the display to the embedded controller to cause the electronic device to enter a special brightness adjustment mode when the environmental condition matches the preset condition; and

an adjustment detecting unit coupled to the basic input/output system unit and detecting whether a special brightness adjustment event occurs, under a situation that the environmental condition does not match the preset condition, wherein:

when the special brightness adjustment event occurs, the basic input/output system unit controls the switch unit to electrically connect the display to the embedded controller to cause the electronic device to enter the special brightness adjustment mode; and

when the special brightness adjustment event does not occur, the basic input/output system unit controls the

switch unit to electrically connect the display to the chip to cause the electronic device to enter a general mode;

wherein the adjustment detecting unit further detects whether a special brightness adjustment command is received to adjust the brightness of the display to be higher than a first threshold brightness or lower than a second threshold brightness, so as to determine whether the special brightness adjustment event occurs, wherein the first threshold brightness is greater than the second threshold brightness; and

wherein the brightness of the display is controlled by the embedded controller independently of the chip in the special brightness adjustment mode, and the embedded controller controls the display to electrically connect to the chip to cause the electronic device to enter the general mode, wherein the brightness of the display is controlled by the chip independently of the embedded controller in the general mode.

14. The brightness control apparatus according to claim **13**, wherein the environmental condition comprises at least one of an environmental temperature and an environmental light intensity.

15. The brightness control apparatus according to claim **14**, wherein the preset condition comprises that the environmental temperature is higher than a first preset temperature or lower than a second preset temperature, wherein the first preset temperature is higher than the second preset temperature;

wherein the embedded controller further determines whether the environmental temperature is higher than the first preset temperature or lower than the second preset temperature, and the environmental condition matches the preset condition if the environmental temperature is higher than the first preset temperature or lower than the second preset temperature; and

wherein the embedded controller further notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode when the environmental condition matches the preset condition, and the embedded controller adjusts the brightness of the display to be lower than a preset low brightness after the electronic device enters the special brightness adjustment mode.

16. The brightness control apparatus according to claim **14**, wherein the preset condition comprises that the environmental light intensity is higher than a preset light intensity;

wherein the embedded controller further determines whether the environmental light intensity is higher than the preset light intensity, and the environmental condition matches the preset condition if the environmental light intensity is higher than the preset light intensity; and

wherein the embedded controller further notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode when the environmental condition matches the preset condition, and the embedded controller adjusts the brightness of the display to be higher than a preset high brightness after the electronic device enters the special brightness adjustment mode.

17. The brightness control apparatus according to claim **13**, wherein the environmental condition detecting unit further detects the environmental condition in a period of a power-on self test, and the embedded controller further determines whether the environmental condition matches the preset condition in the period of the power-on self text, wherein the embedded controller notifies the basic input/output system unit to cause the electronic device to enter the special brightness adjustment mode if the environmental condition matches the preset condition.

18. The brightness control apparatus according to claim **13**, wherein the chip controls the brightness according an operating system of the device, and the embedded controller controls the brightness independently of the operating system.

* * * * *